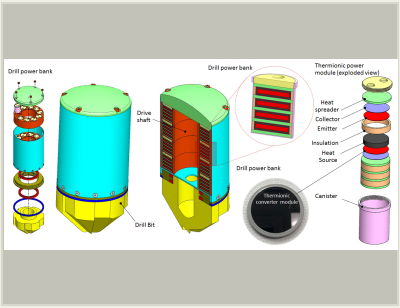
High-Efficiency Thermionic Power Generator, Phase II

Completed Technology Project (2016 - 2019)

Project Introduction

Planetary missions (e.g., Pioneer, Cassini, or Voyager) and applications with moderate power draw and increased mobility requirements (e.g., Curiosity) have successfully employed radioisotope thermoelectric generators (RTGs) as thermal-to-electric power converters. While ~100 We-class radioisotope power sources continue to be in demand, new higher power electric generators (≥500 We) will enable, and enhance, numerous robotic space applications and are ideally suited for upcoming Discovery- through Flagship-class missions. These ≥500 We generators will require both increased source power and increased conversion efficiencies. State-of-the-art thermoelectric generators, for instance, achieve ~7% efficiency, and recent laboratory results are paving a route toward ~15% efficiency. Alternatively, promising results from Lee et al1 and other groups have shown that thermionic thermal-to-electric (TTEC) generators are capable of achieving high conversion efficiency (>25%) at temperatures ≥1200°C by leveraging modern microfabrication techniques. An additional benefit is that the high-quality 'waste heat' from these thermionic systems is rejected at ~800°C, which opens the door to its use as a topping stage for more traditional converters, including thermoelectrics, dramatically raising the ceiling on total system conversion efficiency. To further advance NASA's high-power solid-state thermal-to-electric conversion capabilities, Nanohmics Inc., working in collaboration with The Boeing Company (Huntington Beach, CA) and Sandia National Labs' Center for Integrated Nanotechnologies (CINT) proposes to demonstrate a high-efficiency thermionic thermal-to-electric converter (TTEC) module based on nanostructured, high survivability emission materials. TTEC realization will open up new opportunities for deep space planetary science missions, and future manned spaceflight voyages that are no longer tethered to the sun by photovoltaics.



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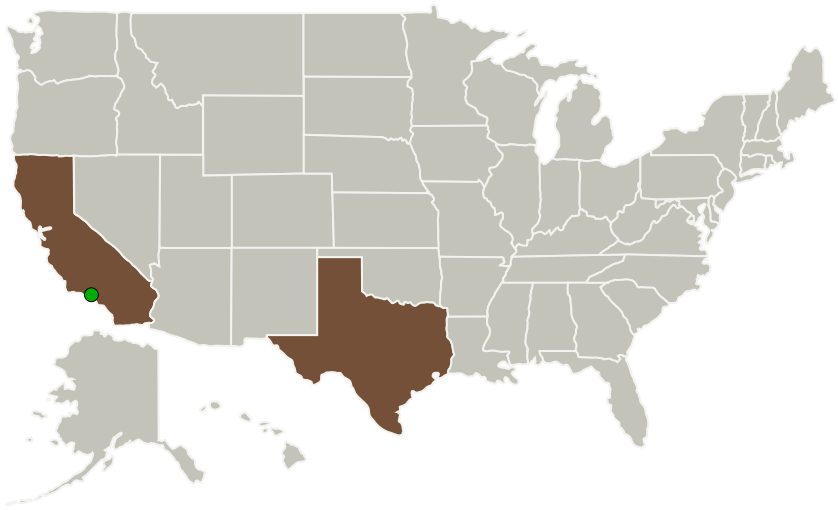
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Nanohmics, Inc.	Lead Organization	Industry	Austin, Texas
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations	
California	Texas

Project Transitions

June 2016: Project Start

June 2019: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140284)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Nanohmics, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

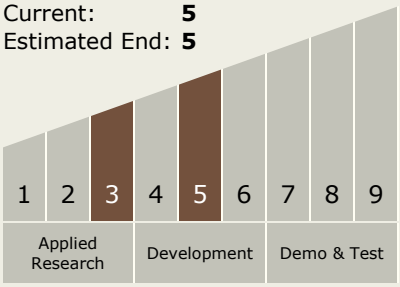
Carlos Torrez

Principal Investigator:

Steve Savoy

Technology Maturity (TRL)

Start: **3**
Current: **5**
Estimated End: **5**



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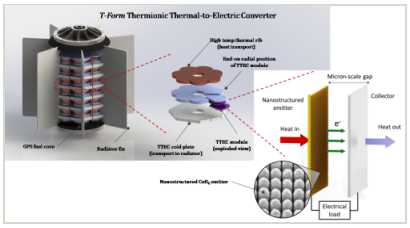
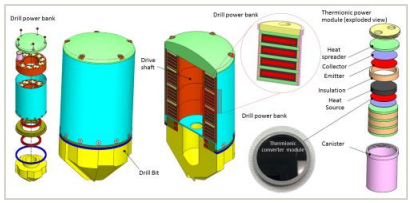
Images



Briefing Chart Image
High-efficiency thermionic power generator, Phase II
(https://techport.nasa.gov/image/128146)



Final Summary Chart Image
High-Efficiency Thermionic Power Generator, Phase II
(https://techport.nasa.gov/image/128711)

Technology Areas

Primary:

- TX03 Aerospace Power and Energy Storage
  - TX03.1 Power Generation and Energy Conversion
    - TX03.1.3 Static Energy Conversion

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System